Developing an IPM Response to a New Wheat Health Threat in New York: Wheat Soilborne Mosaic Virus

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Abstract:

Soil infestation by a new virus, wheat soilborne mosaic virus (WSBMV), was recently confirmed in a localized area of the Finger Lakes region. The virus has the potential to reduce significantly the yield of New York winter wheat. A NYS-IPM supported project was initiated in 2000 with objectives to assess the current range of occurrence of WSBMV in New York, to assess its effect on wheat yield, and to identify adapted winter wheat varieties that are resistant to both SBWMV and wheat spindle streak mosaic virus (WSSMV), another soilborne virus that commonly infects New York wheat. Through cooperative survey with extension educators and seed industry personnel, WSBMV was confirmed during 2000 in Cayuga, Schuyler, Seneca, Steuben, and Tompkins Counties on the wheat cultivars Harus Marilee, Pioneer 25W33, and Caledonia. A WSBMV winter wheat cultivar nursery was established in an infested field in Trumansburg. An identical nursery was planted at Ithaca-Caldwell Field which has a history of WSSMV. Preliminary data on virus reactions of adapted cultivars were collected in 2000. It appears that there is a broad range in virus reaction among New York-adapted cultivars. Farmers in cultivar selection decisions should use only data summarized over multiple years. Cultivar nurseries for 2001 evaluation were planted at both the Trumansburg and Ithaca sites, with two dates of planting at Trumansburg. Based on the year 2000 preliminary results, proposals have been submitted to the NE-IPM and NE-SARE programs of USDA to secure funds for continuation of this project.

Introduction:

Soft winter wheat for pastry flour is a very important cash crop for New York producers as it fits well into dairy, cash grain, and vegetable crop rotations and helps to disrupt the life cycles of pests that damage other predominant crops in these rotations. Rotation is the backbone of IPM for wheat in New York and helps to avoid yield losses incurred in wheat states where there is less frequent rotation. However, rotation is not a useful IPM strategy against certain diseases such as the soilborne viruses. The development and deployment of virus-resistant or virus-tolerant varieties is the most effective IPM strategy against these diseases.

For more than 20 years, a soilborne virus called wheat spindle streak mosaic virus (WSSMV) has been a yield-limiting factor in the production of winter wheat in New York. The disease is transmitted by a soilborne protozoan, *Polymyxa graminis*, which occurs as an obligate parasite of wheat roots in all soils in New York where wheat has once been grown. The vector and the virus persist in the soil for decades, ready to infect wheat seedlings the next time they are planted in an infested soil. Significant gains have been made in the last several years in identifying adapted varieties with partial resistance to WSSMV, and then educating wheat producers so these varieties are grown.

During 1998-99, a new soilborne virus called wheat soilborne mosaic virus (WSBMV) was for the first time confirmed to be present in at least three fields of winter wheat in northwestern Tompkins/southern Seneca Co. Statewide surveys in the 1980s showed the virus to be absent,

suggesting fairly recent introduction. There is an urgent need to assess the geographic spread of this soilborne virus around the foci of infestations in Seneca, Schuyler, and Tompkins Counties and over broader areas of the state in order to determine where new IPM practices should be implemented. Producers with confirmed infestations have already been advised to practice sanitation and avoid moving infested soil to new locations. This virus produces similar symptoms to WSSMV and is also transmitted by *Polymyxa graminis* which is present throughout the state's wheat producing areas. Based on experience in other areas of North America where WSBMV occurs, this virus poses a significant risk to wheat production in New York.

Resistant varieties have been used successfully to diminish losses to WSBMV in other regions. Our challenge is that we have virtually no information on the susceptibility/resistance of soft red and white wheat varieties that are adapted to New York. The severe infestation by WSBMV in a field in Trumansburg provided an opportunity to evaluate wheat varieties for resistance under natural conditions. By sowing the same varieties in a WSSMV-infested soil in Ithaca, we can supply New York growers with accurate recommendations on the specific resistance of varieties to each of the viruses in the soilborne virus complex. The multi-year objectives of this project include: 1) the determination of the current range of occurrence of WSBMV in New York soils, 2) assessment of the relative susceptibility/resistance of adapted, white and red winter wheat varieties and promising breeding lines to WSBMV and WSSMV, 3) determination of the yield impact of WSBMV on yields of susceptible winter wheat, and 4) assessment of the genomic diversity among isolates of WSBMV and WSSMV from New York wheat.

Materials and Methods:

Wheat fields near previously confirmed infestations were surveyed in April 2000 in cooperation with local CCE field crop specialists and seed industry personnel. Plants were collected from fields showing viral symptoms and these samples were analyzed by serological methods in the laboratory to confirm the presence of WSBMV. Extension field crop educators statewide were educated via the Internet (field crops listserve) as to the distinctive symptoms of WSBMV infection and were urged to submit suspect samples to plant pathology for analysis.

Replicated variety trials were planted in October 1999 in Trumansburg (WSBMV infested soil) and Ithaca Caldwell Field (WSSMV infested soil). Twenty-five red wheats and 40 white wheats were evaluated. Plants were rated in May 2000 for visual symptoms of each virus. Representative plant samples were analyzed by serology (ELISA) in the lab for content of each virus.

Results and Discussion:

Through visual inspection and serological assay, we confirmed that WSBMV had indeed spread to other farms in the general vicinity of the three fields in northwestern Tompkins and southern Seneca Co. where we identified the virus in 1999. Furthermore, WSBMV was confirmed during 2000 in more distant (from the earlier sites) locations in Cayuga, Schuyler, Seneca, Steuben, and Tompkins Counties. Dramatic crop stunting was associated with a WSBMV infestation in a North Lansing field. Infections were confirmed on the wheat varieties Harus, Marilee, Pioneer 25W33, and Caledonia. Variety was not always determined. It appears that WSBMV has a wider distribution than we suspected and may spread at a fairly high rate in the future. Expanded survey efforts in central and western New York counties are justified in April 2001. An isolate of the virus from Trumansburg was sent to Professor Renate Koenig at the Virology Laboratory at Braunschweig, Germany. Dr. Koenig (personal communication) found that the RNA sequence of this isolate was distinct from that of all other known furoviruses and that it shared

only 88% homology with a Nebraska strain of WSBMV. Evidence suggests that the New York isolate should be designated as a distinct strain of WSBMV. Future studies will assess similarity among isolates from different regions of New York and the northeastern U.S.

In the variety nursery at Trumansburg we were disappointed by the low incidence of plants showing typical symptoms of WSBMV in April and May. We now believe that low infection incidence was due to dry soil conditions (unfavorable to *Polymyxa*) following planting in fall 1999. Volunteer Marilee wheat plants in the same plots emerged during an earlier period of higher soil moisture and these plants showed a high incidence of WSBMV symptoms. To try to avoid this problem in 2001, we have repeated the Trumansburg nursery at two dates of planting in hopes that at least one planting will be exposed to adequate post-planting soil moisture. Even with the low incidence of infected plants, we were able to observe some differences between varieties in the Trumansburg experiment. For example, based on Trumansburg plots and commercial field observations, it appears that Caledonia may be more resistant than Harus. We will make use of this observation for split-planter yield trials planned for 2001. We had good WSSMV development at Ithaca and were able to discriminate WSSMV reactions of varieties. A preliminary summary of information on soilborne virus reaction in varieties that are currently recommended for planting in New York is provided in Table 1.

Project goals and progress were featured at the Small Grains Management Field Day in June 2000. Preliminary results have been shared with wheat seed company and certified seed cooperative personnel as well as with Cornell extension educators. Based on the year 2000 preliminary results, proposals have been submitted to the NE-IPM and NE-SARE programs of USDA to secure funds for continuation and expansion of this project.

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Table 1. Preliminary information on reaction of New York adapted wheat varieties to two soilborne viruses.

Variety	WSSMV Reaction (Ithaca, May 2000) R = resistant, MR = moderately resistant, MS = moderately susceptible	WSBMV Occurrence (Trumansburg, May 2000) 0 = none + = in at least one subplot ++ = in all subplots
Soft white winter wheat		
ACRon	MS	0
Bavaria	R	0
Caledonia	R	0
Cayuga	R	+
Geneva	R	0
Harus	MR	++
Marilee	MS	0 (volunteer ++)
NYBatavia	MS	+
Pioneer 25W33	R	++
Superior	MS	0
Soft red winter wheat		
Mendon	R	++
Pioneer 25R18	R	+
Triticale		
Presto	R	++